Demand Pull and Supply Push in Portuguese Cable Television Networks: A VAR Approach

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Abstract

In this article a Vector Autoregressive Model is applied to the Portuguese cable television operators, in order to obtain a dynamic analysis of the interactivity established between the supply and the demand of network services. The results reveal the existence of two driving forces, on the one hand, the supply push, which contributes to the enhancement of the basic cable demand, and on the other hand, the demand pull that intensifies the introduction of new services. In the two case studies, it is detected that vertical integration of services has a negative impact on the price of the basic cable.

Key Words: Cable Television, Vector Autoregressive Model.

JEL: C32, C51, L96.

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1. Introduction

With the emerging of the open network paradigm, it is expected that the strategies of the cable television operators will be guided by the dynamics of the interactivity between the supply and the demand of network services, promoted by the vertical integration of services, which embraces the integration of different and complementary functions, on the same distribution network.

In this paper an econometric study of the main Portuguese cable television networks is presented, in order to better understand the interactivity of the supply and the demand of network services, obtained through the implementation of the vertical integration of services strategy. To this effect, two cases are confronted (the incumbent one: TV Cabo; and the entrant one: Cabovisão), in order to analyse the relations between the penetration rate of the cable television service, the demand for the basic service, the price, and the vertical integration of services. The same model is used for identifying the factors that contribute to the reinforcement of the interactivity logic between the supply and the demand of network services, both in a bigger dimension network (the incumbent one), and in a smaller dimension network (the entrant one). In addition to this, an analysis of the impact of the strategy of vertical integration of services on the pricing of the basic cable television service is made.

In the first section, a brief literature review about some empirical studies of Cable Television in the USA is made, and a summary review of the literature relating to the econometric instrument used in both case studies, the Vector Autoregressive (VAR) model; is also made. In the second section, the research methodology is presented, including the objectives and the hypotheses of this study. In the third section, the econometric study is developed, following an empirical strategy which contemplates the development of three sequential phases, namely, the determination of the integration order of the variables, the definition and the estimation of the VAR model, and the presentation of the main results of the dynamic analysis. Finally, the conclusions are presented, taking into consideration a comparative analysis between the results obtained for the incumbent, and for the entrant.

2. Review of Literature

2.1. Empirical Studies

The problematic regarding the estimation of the penetration rate of the basic cable television service was developed in the pioneer studies of Comanor and Mitchel (1971), Park (1972), and Pacey (1985), applied to the main cable television operators in the USA. These studies pointed out that the price influences, significantly, the basic demand [1], and that the number and the quality of the channels offered also influences, positively, the demand level. These findings formed the basis of the carrying out of studies concerning the relation between the demand and the price, as well as of the impact of the regulatory dispositions on the price of this kind of service.

In this context, the study of Mayo and Otsuka (1991) must be noted, concerning the US Cable Television Industry, where the relations between demand, price, and regulatory practice, are analysed, before the deregulation [2].

The authors of that study concluded that the pricing of the basic cable television service depends on operator market power, demand conditions (including the complementarities between the basic and the premium service) and on associated regulatory dispositions.

The results also revealed the existence of some variability in the effects on the alternative ways of regulating the price of the basic service, which led to the conclusion that this price was influenced not only by the marginal cost, and the demand conditions of the premium services, but also by the complementarities between the basic and the premium services. In order to accomplish the price cap established by the regulatory agency, the operators responded with a reduction of the variety of the television channels or with an increase in the price of the premium services which were tied to the basic service (Mayo and Otsuka, 1991).

Waterman and Weiss (1997) pointed out the implications of the situation of vertical integration by the four main US cable operators on performance, on price, and on promotion strategies.

The main results revealed that vertically integrated operators offered a smaller diversity of television channels, in terms of the basic service. These kinds of operators also favoured the premium television channels, in which they had participated. In this sense, they have included frequently the referred channels in the offering of premium cable channels, and also have implemented more aggressive promotional campaigns, which were complemented by the practice of discount prices for the premium channels that were vertically integrated by the cable operator (Waterman and Weiss, 1997).

Chipty (2001) found that the cable operators vertically integrated with premium television channels offered, on average, one less premium service, and one or two fewer basic services than the remaining operators. These operators sell the premium packages more successfully, but they offer services with smaller diversity, at higher prices. They stimulate the demand for premium services, through the supply of smaller and cheaper basic packages.

The operators integrated with the basic channels sell the basic packages more successfully, and in spite of their tendency for excluding certain cable television services from their distribution networks, they stimulate the demand through the supply of some basic packages with a bigger diversity, using a smaller duplication of programs and a greater number of premium services.

Furthermore, Chipty (2001) considers that the sign of the effect of the vertical integration on price is not clear, due to the fact that the operators select so much of the price based upon the quality level of the final service offered to the consumers. On the one hand, the basic integration has a positive effect on the basic price, but a negative effect on the average price of the premium services. On the other hand, the premium integration has a negative effect on the basic price but, even so, has a positive effect on the average price of the premium services.

2.2. Vector Autoregressive Model

The VAR model [3] is especially applied to the analysis of time series and it has been used in an extensive way by several economists, for analysing data, forecasting and making statistical inference.

In the vision of Sims (1980), the VAR model permits the determination of the existence of interrelations between the set of endogenous variables included in the system. The main advantage of using this kind of model derives from the capacity to analyze the dynamic response of the endogenous variables of the system, through the use of the analysis of Variance Decomposition, and the Impulse-Response Functions.

The Variance Decomposition of the forecast error, in terms of the components associated with the different disturbances, provides the identification of the sources of the fluctuation of variables. The Impulse-Response Functions intended as dynamic multipliers reveal the variation of the endogenous variables, which is provoked by a unitary impulse in random disturbances of the system (Ballabriga, 1991; Watson, 1994).

In the ambit of the analysis of the long term economic relations, several pioneer works should be mentioned which discuss the cointegration concept, namely, Granger (1983), Granger and Weiss (1983), and Engle and Granger (1987).

The construction of cointegrated models involves two fundamental steps, namely, the determination of the cointegration degree (that is, the number of unit roots in the model), and the estimation of the unknown parameters (Lütkepohl, 1999).

3. Research Methodology

3.1. Objectives

We consider that the Portuguese Cable Television Sector is an appropriate unit of analysis for making a contrast between the strategies of two different operators: incumbent, versus entrant; although, taking into consideration the simultaneous practice of vertical integration of services.

In the scenario of vertical integration of services performed by each operator, which use package tie-in sales of different network services, for example, television, Internet, fixed telephone and other complementary services which are technologically-related.

In this sense, we present a dynamic analysis [4] of the impact on the strategy of pricing for the basic service arising from the implementation of the vertical integration strategy of services, both for a vertically integrated operator, and for an operator which is not vertically integrated.

In a broad sense, the interest of this study is, fundamentally, based on the fact that the Cable Television Sector has a significant weight in the Portuguese Services Communications Structure, and the need for analyse the different strategies implemented by the main cable television operators, in terms of the organization of activities, the installed network, and pricing. In a more specific sense, we will be analysing the dynamic relation between the penetration rate of the cable television service and the basic demand, as well as the relation between the basic demand and the vertical integration of services. Furthermore, we aim to understand the effect due to the implementation of the strategy of vertical integration of services on the price of the basic service.

3.2. Hypotheses

Taking into consideration the fact that there is a mixture of television services offered in the Portuguese Cable Television Sector, Internet and fixed telephone through bidirectional networks, which may generate network externalities, and incorporating the visions of Katz and Shapiro (1985), Hayashi (1992), Economides and Himmelberg (1995) and Economides (1996), in relation to the problem concerning the realized expectations, given the referred network externalities, it interests to identify and clarify the existence of dynamic and interactive forces between the supply and the demand, as was proposed, in theoretical terms, by Geroski (2003), as well as the resultant implications, in terms of the vertical integration of services and pricing strategies, on the part of the cable television operators.

In the present study, the following hypotheses are considered:

- *Hypothesis 1*: The penetration rate of cable television services presents a positive relation with the price of the basic service.

- *Hypothesis 2*: The vertical integration of services has a negative effect on the price of the basic service.

- *Hypothesis 3*: The penetration rate of cable television services has a positive relation with basic demand.

- *Hypothesis 4*: The basic demand intensifies the vertical integration of services.

- *Hypothesis 5*: The basic demand has a negative relation with price, in the bigger dimension network.

- *Hypothesis 6*: The basic demand has a positive relation with price, in the smaller dimension network.

4. The Econometric Study

In this item, an econometric study [5] is developed for the two main cable television operators in Portugal, TV Cabo (since the 1stT: 1995, until the 3rdT:2003) [6] and Cabovisão (from 4thT: 1996, until the 3rdT:2003), using the same selected VAR model.

4.1. Integration Order of the Variables

An important subject for using the VAR model is the analysis and evaluation of the time series used in the study. First, we will evaluate if the time series are integrated or not, and, then, if so, we will determine the integration order of the variables, in order to find the best way for making it stationary.

To determine the integration order of the variables, we will consider the tests proposed by Dickey and Fuller (1979), which establish the specifications of a model including an endogenous lagged variable, expressed by the following:

$$Y_t = \rho Y_{t-1} + \varepsilon_t \tag{1.}$$

Therefore, the following null hypothesis is tested:

$$H_0 : \rho = \rho_0, \quad |\rho_0| < 1 \tag{2.}$$

This test can be made, using the *t* statistic, or the following statistic:

$$\frac{\hat{\rho} - \rho_0}{S_{\hat{\rho}}} \approx N(0,1) \tag{3.}$$

where $\hat{\rho}$ is the estimate of the ordinary least square, for the parameter ρ; and $S_{\hat{\rho}}$ is the estimate of the standard deviation of $\hat{\rho}$.

According to Dickey and Fuller (1979), to test the null hypothesis (of existence of a unit root), against the alternative hypothesis, three different models should be taken into consideration, namely:

$$Y_t = \rho Y_{t-1} + \varepsilon_t \text{ (Without constant, and without tendency)} \tag{4.}$$

$$Y_t = \mu + \rho Y_{t-1} + \varepsilon_t \text{ (With constant, and without tendency)} \tag{5.}$$

$$Y_t = \mu + \beta t + \rho Y_{t-1} + \varepsilon_t \text{ (With constant, and with tendency)} \tag{6.}$$

In practice, the tests proposed by Dickey and Fuller (1979) consist of the estimation of the three equations previously presented (4., 5., and 6.), through the use of the method of the Ordinary Least Square (*OLS*), and of the realization of the forementioned test of statistical significance $(H_0 : \rho = 1)$.

In an alternative way, we may estimate the following equations:

$$\Delta Y_t = \gamma Y_{t-1} + \varepsilon_t \tag{7.}$$

$$\Delta Y_t = \mu + \gamma Y_{t-1} + \varepsilon_t \tag{8.}$$

$$\Delta Y_t = \mu + \beta t + \gamma Y_{t-1} + \varepsilon_t \tag{9.}$$

where $\gamma = \rho - 1$; in this case, the test of the null hypothesis $H_0 : \rho = 1$, is equivalent to the test of the hypothesis $H_0 : \gamma = 0$. The alternative hypothesis is expressed by $H_1 : \gamma < 0$.

An alternative to the forementioned *DF* tests is the use of the Augmented Dickey--Fuller Test (*ADF*), including a minimum number of lags in the dependent variable, in order to eliminate the possible observance of error autocorrelation.

Marques (1998) advocates that, during the first phase of the *ADF* tests, we should follow the same logic as the simple *DF* tests, whereas, in the second phase, we should carry out the tests of the null hypotheses. So, we consider the results obtained through the estimation of the three following models:

$$\Delta Y_t = \gamma Y_{t-1} + \sum_{j=1}^{p-1} \delta_j \Delta Y_{t-j} + \varepsilon_t \tag{10.}$$

$$\Delta Y_t = \mu + \gamma Y_{t-1} + \sum_{j=1}^{p-1} \delta_j \Delta Y_{t-j} + \varepsilon_t \tag{11.}$$

$$\Delta Y_t = \mu + \beta t + \gamma Y_{t-1} + \sum_{j=1}^{p-1} \delta_j \Delta Y_{t-j} + \varepsilon_t \tag{12.}$$

In the $DF(\gamma)$ tests and the $ADF(\gamma)$ tests, the null hypothesis $H_0 : \gamma = \rho - 1 = 0$, is tested, against the alternative hypothesis $H_1 : \gamma < 0$. The non-rejection of H_0, when $\hat{\gamma}$ is non significant, leads to the conclusion that the time series is not stationary (that is, integrated), or that it presents a unit root.

In order to specify the model, which provides the best adjustment, we make use of two different information criteria, that is, the Akaike Information Criteria (*AIC*), and the Schwarz Bayesian Criteria (*SBC*), in order to select the model that minimizes the values obtained for the forementioned criteria.

For detecting error autocorrelation, the *LM* test is used, and the probability of the *Q* statistic, originally, proposed by Ljung and Box (1979), is also computed, taking into consideration the correlograms generated from the estimation process. Next, the results of the *DF* tests and the *ADF* tests applied to the variables of the case of TV Cabo are presented.

*********** Please insert Table I here. ***********

Since the observed δ, in module, is smaller than the correspondent critical value (in module, too), so the H_0 is not rejected, at a 5% significance level (α). From this, we can conclude that the time series (bp) is integrated, or that it has a unit root.

*********** Please insert Table II here. ***********

As the observed δ, in module, is smaller than the critical values, in module, so the H_0 is not rejected, at a 5% significance level, from this we can conclude that the time series (pen) and (bd) are also integrated, or that they have a unit root.

The endogenous variables that are going to be included in the VAR model, for the incumbent operator, such as, the penetration rate (*pen*), the variation of the demand for cable television (*bd*), and the price of the basic service (*bp*), are not stationary, or integrated. The variables, in first differences, are stationary, so the three time series, in study, are integrated of order *1*, or *I(1)*.

In the case of Cabovisão, the results obtained from the process of determination of the integration order of the variables, are transcribed in the Tables III and IV.

*********** Please insert Table III here. ***********

In this case, the observed δ, in module, is smaller than the critical value, in module, so the H_0 is not rejected, at a 5% significance level. From this, we can derive that the time series (*bp*) is integrated, or that it has a unit root.

*********** Please insert Table IV here. ***********

Since the δ observed, in module, are smaller than the critical values, in module, so the H_0 is not rejected, at a 5% significance level. From this, in the entrant case, we can also derive that the time series (*pen*, and *bd*), are integrated, or that they have a unit root. Therefore, the variables that are going to be included in the VAR model applicable to the entrant are not stationary, or integrated. The variables, in first differences, are also stationary. This find confirms that the original series are *I(1)*.

4.2. The VAR Model

After determining the integration order of the variables, which reveal that the totality of the variables is integrated of order *1*, we proceed to present the VAR model that is going to be tested.

The VAR model is constituted by a system with four equations, including four endogenous variables, which is represented by:

$$pen_t = \alpha_{1t} + \sum_{p=1}^{k} \beta_{1p} pen_{t-p} + \sum_{p=1}^{k} \sigma_{1p} bd_{t-p} + \sum_{p=1}^{k} \theta_{1p} bp_{t-p} + \sum_{p=1}^{k} \Omega_{1p} vis_{t-p} + u_{1t}$$

$$bd_t = \alpha_{2t} + \sum_{p=1}^{k} \beta_{2p} pen_{t-p} + \sum_{p=1}^{k} \sigma_{2p} bd_{t-p} + \sum_{p=1}^{k} \theta_{2p} bp_{t-p} + \sum_{p=1}^{k} \Omega_{2p} vis_{t-p} + u_{2t}$$

$$bp_t = \alpha_{3t} + \sum_{p=1}^{k} \beta_{3p} pen_{t-p} + \sum_{p=1}^{k} \sigma_{3p} bd_{t-p} + \sum_{p=1}^{k} \theta_{3p} bp_{t-p} + \sum_{p=1}^{k} \Omega_{3p} vis_{t-p} + u_{3t}$$

$$vis_t = \alpha_{4t} + \sum_{p=1}^{k} \beta_{4p} pen_{t-p} + \sum_{p=1}^{k} \sigma_{4p} bd_{t-p} + \sum_{p=1}^{k} \theta_{4p} bp_{t-p} + \sum_{p=1}^{k} \Omega_{4p} vis_{t-p} + u_{4t} \qquad (13.)$$

where: *pen* is the penetration rate of the cable television service or network density, given by the quotient between the number of subscribers and the number of cabled households;

bd is the variation of the number of subscribers of the basic cable television service;

bp is the price of the basic cable television service;

vis is the dummy variable concerning the vertical integration of services (equal to *0*, if does not exist *vis*, and equal to *1*, otherwise);

$p = 1,\ldots,k$ is the number of lags, taking k as the optimal number of lags (p_{max});

and t is the corresponding trimester.

4.2.1. Optimal Number of Lags

Now, we proceed to the selection of the optimal number of lags (p_{max}), considering the results of five different information criterias, namely, the Likelihood Ratio (*LR*), the Final Prediction Error (*FPE*), the Akaike Information Criteria (*AIC*), the Schwarz Bayesian Criteria (*SBC*), and the Hannan and Quinn Criteria (*HQ*). Firstly, we present the results concerning to the case of TV Cabo.

*********** Please insert Table V here. ***********

In order to determine the existence (or not) of error autocorrelation, we present the results of the *LM* tests, and the probabilities of the *Q* statistic (*PQ(12)*)[7], and the probabilities of the corresponding adjusted value (*PQ(12) Ad.*).

*********** Please insert Table VI here. ***********

By the results of the tests for detecting an hypothetic error autocorrelation, simulating VAR models, with *1* and *2* lags, respectively, we found that the VAR model should be estimated, using just *1* lag, since this option provides the minimization of the values of the information criterias: *AIC* and *SBC*; guaranteeing also the inexistence of error autocorrelation.

In what concerns to the case of Cabovisão, the results obtained from the process for selecting the optimal number of lags (p_{max}) are transcribed in the Table VII.

*********** Please insert Table VII here. ***********

In order to determine the occurrence (or not) of error autocorrelation, the results of the *LM* tests are presented, as well as the probabilities associated to the *Q* statistic (*PQ(12)*) and to the corresponding adjusted value (*PQ(12) Ad.*).

*********** Please insert Table VIII here. ***********

Lütkepohl (1999) states that the *AIC* overestimates the order, in an asymptotic way, with positive probability, whereas the *SBC* provides the estimation of the order, in a consistent way, if the VAR process for generating information has a finite order. Therefore, we proceed with the estimation of a VAR model, with one lag, taking into consideration, on the one hand, the result of the *SBC*, and on the other hand, the reduced number of observations (only, 28 trimesters), and the use of four variables in the estimation process. Besides, by carrying out several tests, it was verified that this model provides the minimum values for the *AIC* and the *SBC*, without occurrence of error autocorrelation.

4.2.2. Cointegration Tests

Based on the cointegration concept developed by Engle and Granger (1987), if from a VAR model there results a unique cointegrating vector, then this reveals the existence of a long term economic relation between the variables, in study, which is expressed, through a system constituted by *I(1)* variables (not stationary), which produce a linear combination that is stationary, or *I(0)*.

In the methodology proposed by Johansen (1988, 1991), and Johansen and Juselius (1990), it is established the possibility of existence of more than one cointegrating vector, through the determination of the largest possible number of cointegrating vectors, in function of the totality of the endogenous variables included in the system. For this purpose, it can be taken as a reference, a VAR model with an order equal to *p*, including a *Y* vector with an order *n*, which contains the totality of the variables (integrated of order *1*, that is, *I(1)*) expressed by the following:

$$Y_t = \mu + \sum_{i=1}^{p} \Phi_i Y_{t-i} + \varepsilon_t \tag{15.}$$

where Y_t is the vector of integrated variables of order *1*, of the type (*nx1*); Φ_i is the matrix of the parameters (*nxn*); μ is the vector of the deterministic terms; and ε_t is the vector of the white noise residuals (*nx1*).

The error correction model is expressed by:

$$\Delta Y_t = \mu + \sum_{i=1}^{p-1} \Gamma \Delta Y_{t-i} + \Pi Y_{t-i} + \varepsilon_t \tag{16.}$$

where Γ is the matrix of short term relations; and Π is the matrix of long term relations.

The rank of Π (that is, *r*) corresponds to the number of linearly independent vectors, that is, the number of cointegrating vectors, obtained from the endogenous variables included in the Y_t vector . In this context, we can consider three possible scenarios:

a) If $r(\Pi) = 0$, then there are no stationary combinations. In this case, we should estimate a VAR model with the variables expressed in first differences.

b) If $r(\Pi) = n$, then the Y_t vector is stationary. In this case, we should estimate a VAR model with the variables expressed in level.

c) If $r(\Pi) = r < n$, then there are *r* cointegrating vectors which correspond to the number of equilibrium relations, in the long term.

Based on the principle of the maximum likelihood, for making the contrast between the Eigenvalues of the Π matrix, we are going to consider the following statistics (Johansen and Juselius, 1990):

i) **The Trace Statistic** (λ_{Trace}) (17.)

This statistic provides the contrast between the null hypothesis (H_0), that is, the number of cointegrating vectors is smaller or equal to *r*, and the alternative hypothesis (H_1), that is, the number of cointegrating vectors is bigger than *r*, that is, $H_0 : r \leq r_0$, against $H_1 : r > r_0$.

ii) **The Max-Eigenvalue Statistic** (λ_{Max}) (18.)

These statistics provide the contrast between the (H_0), that is, the number of cointegrating vectors is equal to *r*, and the (H_1), that is, the number of cointegrating vectors is equal to *r+1*, that is, $H_0 : r = r_0$ against $H_1 : r = r_0 + 1$.

In the case of TV Cabo, the results of the cointegration tests proposed by Johansen and Juselius (1990) are transcribed in the Table IX.

*********** Please insert Table IX here. ***********

By observing the third line of the Table IX, we see that the values obtained for Max-Eigenvalue Statistic and for the Trace Statistic are smaller than the critical values. Therefore, the (H_0) relating to the existence of two cointegrating vectors cannot be rejected, against the (H_1) concerning to the existence of at least three cointegrating vectors, at a confidence level of 95%. The integrated variables of order *1* have similar behaviours in the long term, and their representation is according to the two cointegrating vectors, which will be considered in the estimation of the VAR model, with two error correction terms (ECT).

In the case of Cabovisão, the results of the cointegration tests are seen in the Table X.

*********** Please insert Table X here. ***********

From the analysis of the second line of Table X, we note that the observed values for the Max-Eigenvalue Statistic and for the Trace Statistic are smaller than the critical values. Thus, the null hypothesis, which states the existence of a unique co-integrating vector, cannot be rejected, with a confidence level of 95%.

The variables *I(1)* included in the system present a similar behaviour in the long term, so the corresponding representation is in conformity with the only one cointegrating vector, which will be included later in the VAR model with an error correction term.

4.3. The Dynamic Analysis

In the present item, a dynamic analysis of the endogenous variables included in the model is made, which permits us to make a simulation of the effects originated by the shocks in the different random disturbances of the system, and to show the importance of each shock through the portion of the variance of the forecast error explained by each variable.

4.3.1. Granger Causality

The causality relations, defined in the terms originally proposed by Granger (1969), represent the capacity of a variable (*X*) included in the system, to assist the forecast of another variable (*Y*), equally included in the system.

According to Sims (1980, p.29), «a test for block-exogeneity has special interest, in the context of a VAR model, because it examines how it will account for the observed cyclical variability of the economy».

In the present case, the contrast of the significance of each causality relation is made, observing the values of the statistics, at two significance levels, 5% and 10%, respectively, whereas in the detection of the significance of the *ECT*, the *t* statistic is used.

In the case of TV Cabo, the use of the exogeneity tests yielded the results presented in Table XI, where the values corresponding to the penetration rate of cable television service (*pen*), the variation of the number of subscribers to the basic cable television service (*bd*), and price of the basic cable television service (*bp*) were, previously, logarithmized.

*********** Please insert Table XI here. ***********

Analysing the Granger Causality Contrasts applied to the case of TV Cabo, we can observe that the variation of the basic demand (*bd*) causes, in a Granger sense, the price of the basic service (*bp*), at a significance level of 5%. Considering the price of the basic service (*pb*) as the dependent variable, the block of variables constituted by the remaining variables included in the system, namely, the penetration rate (*pen*), the variation of the basic demand (*bd*), and the vertical integration of services (*vis*), causes, in a Granger sense, the price of the basic service, at a significance level of 5%.

With regard to unidirectional causality, defined in the sense $\Delta bd \rightarrow \Delta bp$ (that is, demand $\rightarrow$ price), we see confirmation of the fact that the dynamics of the demand of the network services affect the pricing strategy implemented by the incumbent, making use of package tie-in sales of vertically integrated services, which allows a greater valorisation of these services, on the part of the subscribers.

In terms of unidirectional causalities, the observance of a causality defined in the sense $\Delta bd \rightarrow \Delta vis$ must be stressed (that is, demand $\rightarrow$ vertical integration of services), which is justifiable by the effect of the demand pull. This effect is produced by the contribution of the basic demand for intensifying the vertical integration of services.

There is also detected a unidirectional causality which is defined in the sense $\Delta pen \rightarrow \Delta vis$ (that is, penetration rate $\rightarrow$ vertical integration of services), which is justified by the strategic choice of the incumbent, reinforcing the network density, which precedes the introduction of new vertically integrated services.

Concerning to the joint-causality revealed by the remaining variables relative to the strategy of vertical integration of services, we observe that the mixed action of the demand, of the price of the basic service, and of the increase of the network density, does precede the implementation of the strategy of vertical integration of services, on the part of the incumbent.

As concerns the block of the remaining variables, the existence of relations of independence was verified among the variables. The reduced number of observations that is used in the present study can justify this situation.

In the case of Cabovisão, the application of the blocks-exogeneity tests provided the results that are presented in Table XII, where the values of the total of the variables were, previously, logarithmized.

*********** Please insert Table XII here. ***********

Using the analysis of the causality contrasts, we found a unidirectional causality defined, in the sense, $\Delta bp \rightarrow \Delta pen$ (that is, price $\rightarrow$ penetration rate). From here, we conclude that the price of the basic service causes, in a Granger sense, the penetration rate (which measures the network density), at a significance level of 5%.

Considering the network density as the dependent variable, we observed that the block of the remaining variables included in the system causes, in a Granger sense, the penetration rate, at a significance level of 10%. For the remaining blocks of variables we found the existence of relations of independence.

4.3.2. Variance Decomposition of Cholesky

Next, in the case of TV Cabo, the results of the variance decomposition of Cholesky, for 4, 8, 12, and 24 Trimesters, are presented, taking into consideration the percentage weights, for each possible causality relation [8].

*********** Please insert Table XIII here. ***********

Considering the analysis based on the variance decomposition of Cholesky, we conclude that only the price has a direct and significant impact on the penetration rate (that is, the network density).

For a forecast horizon with 8 trimesters, the price (*logbp*) presents a direct impact over the network density (*logpen*), which was computed at 5,20%. Thus, the price presents a causality relation relative to the network density. The same does not happen with the two other variables.

The network density and the vertical integration of services have a direct and significant impact on the basic demand, whereas the price of the basic service does not present a significant impact on the behaviour of the basic demand.

For the same forecast horizon, the direct impact on the demand (*logbd*) was calculated at 27,35%, by action of the network density (*logpen*), and at 6,62%, across the vertical integration of services (*vis*).

These results confirm the importance of the supply push as a mechanism for expanding the subscribers' mass, and for attaining the interactivity between the supply and the demand of network services. Additionally, the vertical integration of services presents a persistent and growing effect on the basic demand, which reinforces the logic of the operator in offering, more and more, new vertically integrated services, in order to expand the number of subscribers.

We found also that, after 8 trimesters, the direct impact on the price of the basic service (*logbp*), was calculated at 22,26%, by action of the network density (*logpen*), at 14,25%, across the basic demand (*logbd*).

The results now presented, confirm the previously detected unidirectional causalities of the network density, and of the demand.

For the same forecast horizon, the direct impact on the vertical integration of services (*vis*) was calculated at 20,14%, across the network density (*logpen*), at 45,70%, by action of the basic demand (*logbd*), and at 5,72% through the price (*logbp*).

From this, we conclude that the basic demand presents a strong causality relative to the strategy of vertical integration of services, implemented by the incumbent, which signals the importance of the demand pull in the diffusion of new vertically integrated services.

In the case of Cabovisão, the results of the variance decomposition, for 4, 8, 12, and 24 Trimesters, are transcribed in the Table XIV [10].

*********** Please insert Table XIV here. ***********

The analysis of the causality relations revealed that the variation of the basic demand, and the price have a direct and persistent effect on the penetration rate (or, network density). For 8 trimesters, the direct impact on the network density (*logpen*) was calculated at 6,20%, by action of the basic demand (*logbd*), and at 20,77%, through the price (*logbp*).

In what concerns the analysis of the causality relations between the variables of the second block, we must stress that the network density only has a significant impact on the basic demand. The price and the vertical integration of services do not present a direct and significant impact on the basic demand. Taking a forecast horizon of 8 trimesters, we observe that only the network density (*logpen*), presents a significant impact, contributing for 15,36% of the explained variance of the forecast error of the basic demand (*logbd*).

In terms of the direct impacts on the price of the basic service (*logbp*), we must stress that the network density (*logpen*) is the one which presents a more significant and persistent effect, since after 8 trimesters, it contributes for 50,12% of the explained variance of the forecast error of the price.

We must stress also that all the variables show a significant impact on the vertical integration of services.

4.3.3. Impulse-Response Functions

In the case of TV Cabo [12], the values of the Impulse-Response Functions, provide the interpretations that are presented here. Firstly, although the response of the price relative to the impulses in the penetration rate is negative, in the first four trimesters, the sign of the causality weight is positive [13]. From here, the deduction of a positive relation between the penetration rate and the price can be made, that is, for an increase in the network density; there is a corresponding increase in the price of the basic service.

Secondly, the response of the price relative to the innovations which occurred in the vertical integration of services is null, in the present period, becoming negative, in the second period. Later on, it is positive, assuming negative values starting from the 6th trimester.

The negative relation between the vertical integration of services and the price of the basic service confirms the previous statistical inference obtained through the analysis of the variance decomposition, which pointed out the existence of a non-significant impact of the vertical integration of services on price.

In the case of TV Cabo, the strategy of vertical integration of services assumes special importance in maximizing the profits obtained by this operator, which is vertically integrated in the *PT Group*, since this situation facilitates the supply of additional services with increased value for the subscribers, obtaining a reduction in the production costs through the property of complementary monopolies [14] conjugated with a solid brand image of the Mother-Company, which permits the reinforcement of the market power of the incumbent.

Thirdly, the response of the basic demand relative to the impulses in the penetration rate is positive and significant, only reaching a negative value starting from the 6th trimester. This result confirms the main results of the analysis of the variance decomposition. On the one hand, this positive relation reveals the importance of the supply push promoted by the incumbent, through the expansion of the number of cabled households, considering that the supply "pushes" the additional subscription of vertically integrated network services, through the same cable distribution network. On the other hand, this confirms the capacity that the monopolist has to influence the consumers' expectations, forcing the consumers to subscribe to the services offered by the bigger dimension network.

Fourthly, the response of the vertical integration of services relative to the impulses in the basic demand is positive and significant, assuming a stable value starting from the 15th trimester.

The importance of the effect of demand pull on the implementation of the strategy of vertical integration of services implemented by the incumbent, referred by Geroski (2003), is also ratified. This effect is expressed by the fact that the basic demand “pulls” the introduction of new vertically integrated services.

Fifthly, the response of the price in relation to the impulses in the basic demand is negative and not very significant. This result is in contrast with the inference obtained through the analysis of the variance decomposition, which has revealed the existence of a significant impact of the demand on prices of the basic service.

In the case of Cabovisão, the values of the impulse-response functions revealed that the response of the price in relation to the impulses in the penetration rate, assumes a positive value. Thus, a positive relation between the penetration rate and the price of the basic service is observed, that is, for every increase in the network density of the entrant, there is a corresponding increase in the basic service price.

Furthermore, the response of the price relative to the impulses in the vertical integration of services is null, in the present moment, and it is positive, in the second period, starting later to be negative, but insignificant. This result confirms the statistical inference of the analysis of the variance decomposition, which confirms the existence of a non-significant effect of the vertical integration of services on the price of the basic service.

As concerning the response of the basic demand relative to the impulses in the penetration rate, this is positive and significant, being stable from the 13th trimester onwards. The result obtained through the analysis of the variance decomposition confirms that the penetration rate has a significant effect on the basic demand. This effect can be explained by the fact that the entrant has available a smaller dimension network. This situation provides the internalization of the positive network externalities observed in the initial phases of the distribution network (that is, the release and the expansion phases).

The response of the vertical integration of services relative to the impulses in the basic demand is positive and significant. This result is confirmed by the analysis of the variance decomposition, which pointed out the existence of a direct and significant impact of the basic demand on the vertical integration of services, nevertheless the weight of the causality to be smaller than the one detected in the incumbent case.

The response of the price of the basic service relative to the impulses in the demand is positive and non significant. According to the result obtained through the analysis of the variance decomposition, this impact is not very significant, and in comparative terms, it is also smaller than the one that was observed in the incumbent case.

In the entrant case, the discovery that the price of the basic service has a positive relation with the demand can be justified by the reduced number of subscribers and by the internalization of the strong network externalities that are observed in the initial phases of the distribution network.

5. Conclusions

From the analysis of the most representative Portuguese cable television operators, we conclude that, the economic variables are integrated of order one, and they are also cointegrated, denoting the existence of long term economic relations.

In the incumbent case, in what concerns to the results of the causality contrasts, three main findings deserve a special mention. First, the demand causes in a Granger sense, the price of the basic service, which reveals the negative impact of the demand on the price. Second, the network density causes in a Granger sense, the vertical integration of services. This ratifies the previous importance of the expansion of the network, in terms of the number of cabled households, which works as a form of supply push. Third, the demand causes in a Granger sense, the vertical integration of services. This ratifies the arguments presented by Geroski (2003), which show the importance of the demand pull for determining the speed of reaction, in terms of the diffusion of new vertically integrated services, on the part of the incumbent.

In the entrant case, the price of the basic service causes in a Granger sense the penetration rate. This allows verifying the importance of the price as a signalling mechanism of the quality of the offered services, and as a financing element of the expansion of the horizontal network dimension.

The differences observed in the causality contrasts reveal the competitive advantage obtained by the incumbent, which is "forced" to intensify the vertical integration of services in order to answer the demand pull, whereas the entrant gives special importance to the physical expansion of the network.

As far as concerns to the results related with the hypotheses of our study, we have to enhance the existence of a positive relation between the penetration rate and the price of the basic service (see the Hypothesis 1). This finding is in contrast with the results obtained in the studies applied to the US cable television industry, accomplished by Comanor and Mitchel (1971), Park (1972), and Pacey (1985), which pointed out the existence of a negative relation between the penetration rate and the price of the basic service.

In the two Portuguese case studies, the results revealed the importance of increasing the network density (during the initial phases: release, and expansion), in determining the increases in the price of the basic service.

We find out, in both cases, that the vertical integration of services has a negative impact on the price (see the Hypothesis 2); nevertheless that impact is observed to be not very significant. This result is in contrast with the results obtained by Mayo and Otsuka (1991), Rubinovitz (1993), and Anstine (2001), which advocated the existence of a positive relation between the price of the basic service and the diversification of cable television offering. Even so, the result now obtained confirms, partially, the findings of Chipty (2001), which pointed out that the premium integration (as it happens in the incumbent case) has a negative effect on the price of the basic service, that is, the operator which practices vertical integration, with premium activities, has an incentive for diversifying the premium services, and for stimulating the demand for these kinds of services, through the offering of smaller basic packages, making use of lower prices.

In both cases, the penetration rate and the demand for the basic service present a positive relation (see the Hypothesis 3). However, compared with the results obtained in the incumbent case, in terms of the coefficients obtained through the impulse-response functions, the penetration rate assumes a greater importance in determining the basic demand in the entrant case. We also empirically confirm the theories presented by Geroski (2003), who establishes the importance of the contribution of the supply push for increasing the demand of network services.

The dynamics of the basic demand for promoting even more vertical integration of services (see the Hypothesis 4), assumes a considerable impact, in both cases. This ratifies the thesis of Geroski (2003), which states that the demand pull contributes to an intensification of the rhythm of diffusion of new vertically integrated services.

Finally, we should stress the differences observed in the two cases, in terms of the relation between the basic demand and the price (see the Hypotheses 5, and 6). In the incumbent case, the existence of a negative relation between the demand and the price of the basic service is detected. This finding justifies the partial covering of the national territory, in order to avoid the pressure for decreasing the price of the basic service. In the entrant case, the existence of a positive relation is observed (although the impact of the demand on the price is not very significant), which is justifiable by the smaller dimension of the entrant network, and by the internalization of the network externalities that are originated trough the transaction of the package tie-in sales of cable television services, and other technologically related services.

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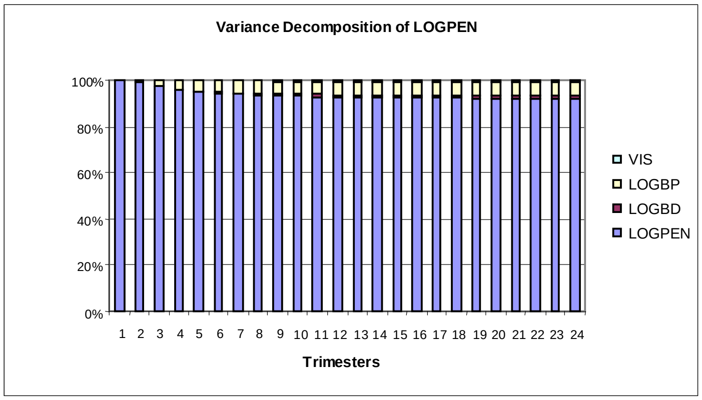
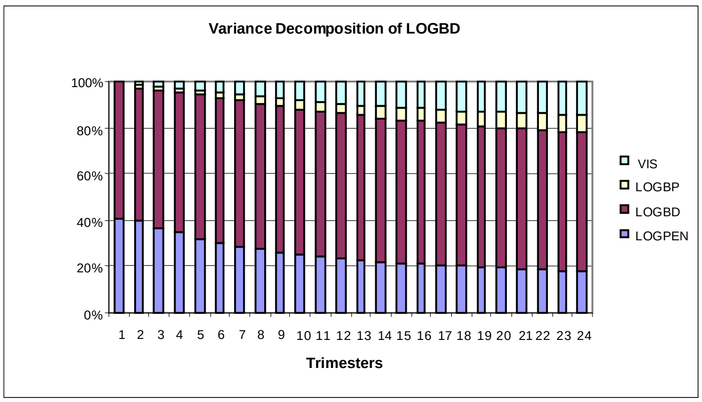
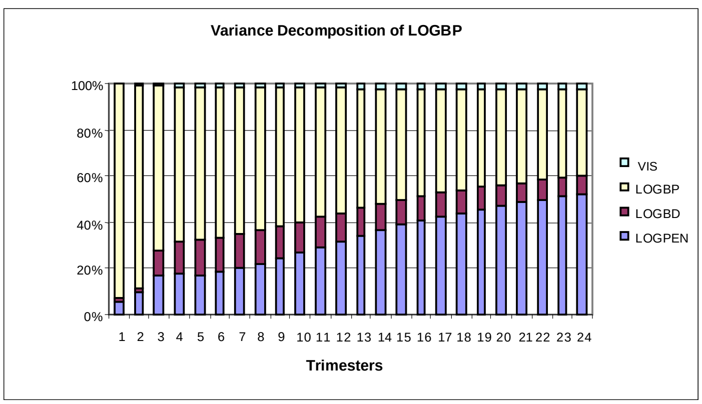
Annexes

Annex 1

Figure 1. – Variance Decomposition of Cholesky (24 Trimesters) – TV Cabo







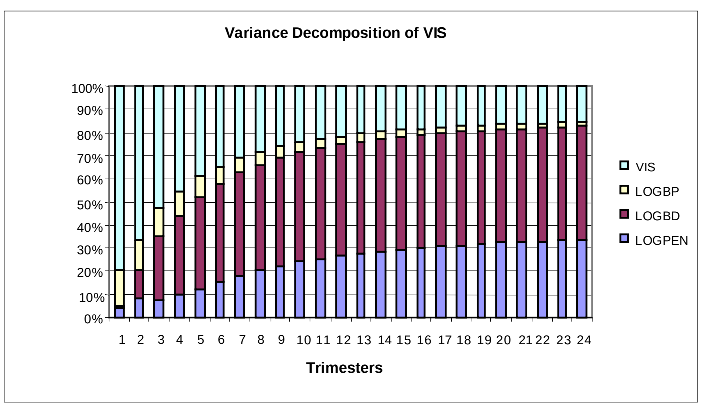


Table XV. – Impulse-Response Functions – TV Cabo

Response of LOGPEN					Response of LOGBD				
H(s)					H(s)	H3			
Per.	LOGPEN	LOGBD	LOGBP	VIS	Per.	LOGPEN	LOGBD	LOGBP	VIS
1	**0.070384**	**0.000000**	**0.000000**	**0.000000**	**1**	**0.338522**	**0.407044**	**0.000000**	**0.000000**
2	0.075621	0.000700	-0.007670	-0.003600	2	0.033246	0.039065	-0.076429	0.066645
3	0.088053	0.003880	-0.019367	-0.004295	3	0.122750	0.214466	0.008876	0.063538
4	**0.096672**	**0.004245**	**-0.026151**	**-0.004595**	**4**	**0.028342**	**0.131375**	**0.023659**	**0.060718**
5	0.106231	0.009464	-0.027293	-0.006506	5	0.038757	0.168361	0.047870	0.062325
6	0.112025	0.012000	-0.027819	-0.008312	6	-0.008438	0.127824	0.041502	0.069983
7	0.115850	0.013522	-0.028842	-0.009247	7	-0.012490	0.134787	0.045637	0.074700
8	**0.117881**	**0.013790**	**-0.030252**	**-0.009558**	**8**	**-0.027290**	**0.124715**	**0.047687**	**0.076831**
9	0.119580	0.014290	-0.031188	-0.009748	9	-0.028949	0.128508	0.053032	0.077125
10	0.120875	0.014753	-0.031646	-0.009985	10	-0.035349	0.124798	0.054854	0.077674
11	0.121882	0.015200	-0.031848	-0.010217	11	-0.037979	0.124524	0.056036	0.078404
12	**0.122518**	**0.015432**	**-0.032030**	**-0.010371**	**12**	**-0.041179**	**0.122638**	**0.056289**	**0.079099**
13	0.122940	0.015565	-0.032209	-0.010452	13	-0.042471	0.122477	0.056909	0.079470
14	0.123226	0.015645	-0.032351	-0.010498	14	-0.043684	0.121986	0.057393	0.079650
15	0.123445	0.015722	-0.032436	-0.010537	15	-0.044342	0.121888	0.057801	0.079758
16	**0.123604**	**0.015782**	**-0.032485**	**-0.010570**	**16**	**-0.044979**	**0.121606**	**0.057989**	**0.079868**
17	0.123716	0.015824	-0.032518	-0.010594	17	-0.045374	0.121473	0.058111	0.079961
18	0.123790	0.015849	-0.032546	-0.010609	18	-0.045677	0.121348	0.058194	0.080025
19	0.123841	0.015866	-0.032567	-0.010619	19	-0.045857	0.121298	0.058274	0.080062
20	**0.123878**	**0.015878**	**-0.032582**	**-0.010625**	**20**	**-0.045995**	**0.121250**	**0.058330**	**0.080086**
21	0.123905	0.015888	-0.032591	-0.010631	21	-0.046089	0.121220	0.058369	0.080103
22	0.123924	0.015894	-0.032598	-0.010635	22	-0.046161	0.121192	0.058391	0.080118
23	0.123937	0.015899	-0.032602	-0.010637	23	-0.046209	0.121175	0.058407	0.080128
24	**0.123946**	**0.015902**	**-0.032606**	**-0.010639**	**24**	**-0.046243**	**0.121163**	**0.058420**	**0.080135**

Response of LOGBP					Response of VIS				
H(s)	H1	H5		H2	H(s)		H4		
Per.	LOGPEN	LOGBD	LOGBP	VIS	Per.	LOGPEN	LOGBD	LOGBP	VIS
1	**-0.003726**	**-0.002307**	**0.015376**	**0.000000**	**1**	**-0.028867**	**0.014238**	**0.057590**	**0.130310**
2	-0.004777	0.001081	0.009535	-0.002076	2	-0.047068	0.065547	0.040231	0.087137
3	-0.006507	-0.006544	-7.42E-05	0.000967	3	0.035881	0.105366	0.041072	0.072719
4	**-0.002788**	**-0.004567**	**-0.002062**	**0.001637**	**4**	**0.052382**	**0.103797**	**0.037090**	**0.065774**
5	0.000385	-0.002373	-0.000955	0.000424	5	0.071339	0.114008	0.030157	0.062467
6	0.002896	-0.000488	7.72E-05	-0.000651	6	0.077910	0.111093	0.020912	0.062088
7	0.003394	-0.000650	-0.000343	-0.000907	7	0.088083	0.115939	0.017405	0.061031
8	**0.003696**	**-0.000831**	**-0.001100**	**-0.000784**	**8**	**0.094115**	**0.117982**	**0.015887**	**0.059482**
9	0.003997	-0.000878	-0.001534	-0.000722	9	0.099349	0.120683	0.015277	0.058201
10	0.004461	-0.000608	-0.001565	-0.000808	10	0.101923	0.121252	0.014129	0.057564
11	0.004770	-0.000435	-0.001524	-0.000919	11	0.103932	0.121896	0.013133	0.057276
12	**0.004944**	**-0.000359**	**-0.001547**	**-0.000975**	**12**	**0.105247**	**0.122213**	**0.012428**	**0.057074**
13	0.005020	-0.000363	-0.001622	-0.000984	13	0.106381	0.122689	0.012098	0.056862
14	0.005085	-0.000353	-0.001678	-0.000985	14	0.107132	0.122970	0.011893	0.056686
15	0.005144	-0.000332	-0.001700	-0.000993	15	0.107662	0.123173	0.011731	0.056571
16	**0.005192**	**-0.000308**	**-0.001705**	**-0.001006**	**16**	**0.107996**	**0.123269**	**0.011582**	**0.056507**
17	0.005222	-0.000295	-0.001710	-0.001014	17	0.108243	0.123351	0.011476	0.056465
18	0.005240	-0.000290	-0.001718	-0.001018	18	0.108420	0.123411	0.011409	0.056432
19	0.005251	-0.000288	-0.001726	-0.001019	19	0.108550	0.123461	0.011368	0.056405
20	**0.005261**	**-0.000284**	**-0.001730**	**-0.001021**	**20**	**0.108638**	**0.123492**	**0.011339**	**0.056386**
21	0.005268	-0.000282	-0.001732	-0.001022	21	0.108699	0.123513	0.011316	0.056374
22	0.005273	-0.000279	-0.001733	-0.001023	22	0.108742	0.123527	0.011299	0.056366
23	0.005276	-0.000278	-0.001734	-0.001024	23	0.108772	0.123537	0.011287	0.056361
24	**0.005279**	**-0.000278**	**-0.001735**	**-0.001024**	**24**	**0.108794**	**0.123545**	**0.011280**	**0.056356**

Notes:

[1] In the Table XV, for each quadrant, the entrance, in column, corresponds to the impulse function, in each variable, taking into consideration the entrance order of the variables in the model, which originates the response coefficients from the variable presented in line (for example, in the top left area, the response of LOGPEN).

[2] The shaded areas correspond to the impulse-response functions associated with the hypotheses in study (H1, H2, H3, H4, and H5), in the case of TV Cabo.

Annex 2

Figure 2. – Variance Decomposition of Cholesky (24 Trimesters) – Cabovisão

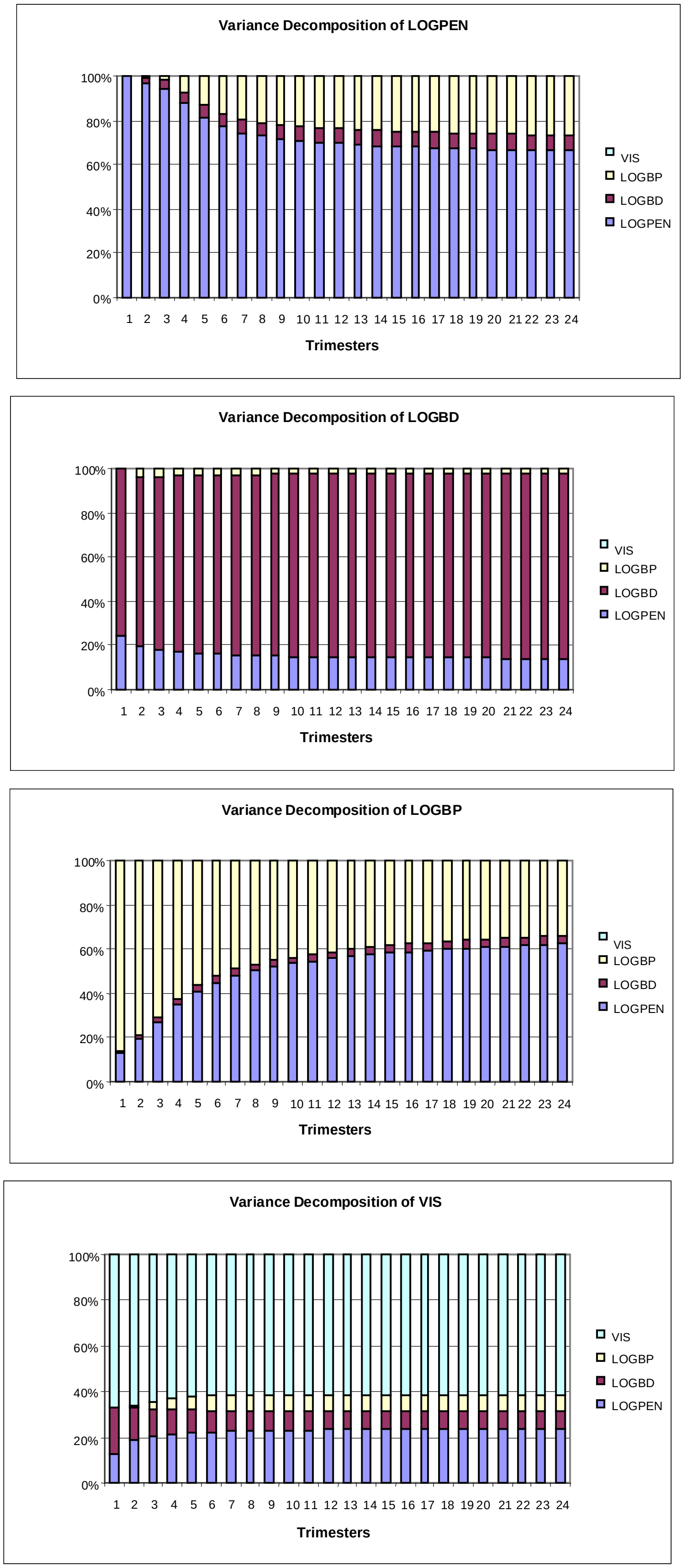


Table XVI. – Impulse-Response Functions – Cabovisão

Response of LOGPEN					Response of LOGBD				
H(s)					H(s)	H3			
Per.	LOGPEN	LOGBD	LOGBP	VIS	Per.	LOGPEN	LOGBD	LOGBP	VIS
1	**0.090339**	**0.000000**	**0.000000**	**0.000000**	**1**	**0.488988**	**0.859294**	**0.000000**	**0.000000**
2	0.113490	0.021536	-0.012131	-0.009223	2	0.324944	0.792776	-0.262886	0.055626
3	0.105517	0.028356	0.020266	-0.005598	3	0.326484	0.759155	-0.163197	0.035761
4	**0.094168**	**0.031724**	**0.052492**	**0.000412**	**4**	**0.320292**	**0.780054**	**-0.112826**	**0.046538**
5	0.086472	0.031932	0.066499	0.004585	5	0.307388	0.778524	-0.104012	0.053016
6	0.083968	0.030682	0.067509	0.005858	6	0.305328	0.775593	-0.104484	0.053572
7	0.084534	0.029686	0.063772	0.005524	7	0.306901	0.774683	-0.110025	0.052843
8	**0.085808**	**0.029283**	**0.060343**	**0.004839**	**8**	**0.308628**	**0.774272**	**-0.114547**	**0.051917**
9	0.086664	0.029276	0.058773	0.004386	9	0.309658	0.774316	-0.116212	0.051363
10	0.086944	0.029406	0.058626	0.004241	10	0.309915	0.774517	-0.116118	0.051235
11	0.086890	0.029514	0.059024	0.004273	11	0.309778	0.774655	-0.115494	0.051313
12	**0.086753**	**0.029560**	**0.059399**	**0.004347**	**12**	**0.309583**	**0.774702**	**-0.115011**	**0.051417**
13	0.086658	0.029562	0.059575	0.004397	13	0.309469	0.774695	-0.114822	0.051477
14	0.086626	0.029548	0.059594	0.004414	14	0.309439	0.774674	-0.114827	0.051492
15	0.086632	0.029536	0.059552	0.004411	15	0.309453	0.774659	-0.114894	0.051484
16	**0.086646**	**0.029531**	**0.059511**	**0.004403**	**16**	**0.309474**	**0.774654**	**-0.114947**	**0.051473**
17	0.086657	0.029530	0.059491	0.004397	17	0.309487	0.774654	-0.114969	0.051466
18	0.086660	0.029532	0.059489	0.004395	18	0.309490	0.774656	-0.114968	0.051465
19	0.086660	0.029533	0.059493	0.004395	19	0.309489	0.774658	-0.114961	0.051465
20	**0.086658**	**0.029534**	**0.059498**	**0.004396**	**20**	**0.309487**	**0.774659**	**-0.114955**	**0.051467**
21	0.086657	0.029534	0.059500	0.004397	21	0.309485	0.774659	-0.114953	0.051467
22	0.086657	0.029534	0.059500	0.004397	22	0.309485	0.774658	-0.114953	0.051468
23	0.086657	0.029533	0.059500	0.004397	23	0.309485	0.774658	-0.114954	0.051468
24	**0.086657**	**0.029533**	**0.059499**	**0.004397**	**24**	**0.309485**	**0.774658**	**-0.114954**	**0.051467**

Response of LOGBP					Response of VIS				
H(s)	H1	H6		H2	H(s)		H4		
Per.	LOGPEN	LOGBD	LOGBP	VIS	Per.	LOGPEN	LOGBD	LOGBP	VIS
1	**0.009284**	**0.002171**	**0.023971**	**0.000000**	**1**	**-0.073831**	**0.093358**	**0.011971**	**0.169963**
2	0.010189	0.004114	0.014207	0.000845	2	-0.101143	0.052337	0.026410	0.161279
3	0.011552	0.002445	0.008034	-0.000382	3	-0.100408	0.059327	0.062403	0.163382
4	**0.013048**	**0.002538**	**0.006376**	**-0.001164**	**4**	**-0.105997**	**0.060867**	**0.066162**	**0.167264**
5	0.013368	0.002853	0.006409	-0.001291	5	-0.107246	0.058869	0.064116	0.167487
6	0.013194	0.002997	0.007127	-0.001203	6	-0.106122	0.058295	0.060997	0.166899
7	0.012966	0.003055	0.007720	-0.001081	7	-0.105131	0.058176	0.058657	0.166393
8	**0.012827**	**0.003050**	**0.007953**	**-0.001007**	**8**	**-0.104630**	**0.058225**	**0.057901**	**0.166122**
9	0.012789	0.003025	0.007950	-0.000988	9	-0.104537	0.058339	0.058060	0.166076
10	0.012805	0.003007	0.007871	-0.000997	10	-0.104634	0.058411	0.058431	0.166130
11	0.012830	0.003000	0.007807	-0.001010	11	-0.104744	0.058431	0.058684	0.166189
12	**0.012846**	**0.003000**	**0.007780**	**-0.001018**	**12**	**-0.104801**	**0.058424**	**0.058769**	**0.166219**
13	0.012850	0.003003	0.007780	-0.001021	13	-0.104812	0.058411	0.058754	0.166224
14	0.012849	0.003005	0.007789	-0.001020	14	-0.104801	0.058404	0.058714	0.166218
15	0.012846	0.003006	0.007796	-0.001018	15	-0.104789	0.058401	0.058686	0.166212
16	**0.012844**	**0.003006**	**0.007799**	**-0.001017**	**16**	**-0.104783**	**0.058402**	**0.058676**	**0.166209**
17	0.012844	0.003006	0.007799	-0.001017	17	-0.104782	0.058403	0.058678	0.166208
18	0.012844	0.003005	0.007798	-0.001017	18	-0.104783	0.058404	0.058682	0.166209
19	0.012844	0.003005	0.007797	-0.001017	19	-0.104784	0.058404	0.058685	0.166209
20	**0.012844**	**0.003005**	**0.007797**	**-0.001017**	**20**	**-0.104785**	**0.058404**	**0.058686**	**0.166210**
21	0.012844	0.003005	0.007797	-0.001018	21	-0.104785	0.058404	0.058686	0.166210
22	0.012844	0.003005	0.007797	-0.001018	22	-0.104785	0.058404	0.058686	0.166210
23	0.012844	0.003005	0.007797	-0.001017	23	-0.104785	0.058404	0.058685	0.166210
24	**0.012844**	**0.003005**	**0.007797**	**-0.001017**	**24**	**-0.104785**	**0.058404**	**0.058685**	**0.166210**

Notes:

[1] In the Table XVI, for each quadrant, the entrance, in column, corresponds to the impulse function, in each variable, taking into consideration the entrance order of the variables in the model, which originates the response coefficients from the variable presented in line.

[2] The shaded areas correspond to the impulse-response functions associated with the hypotheses in study (H1, H2, H3, H4, and H6), in the case of Cabovisão.

Table I. – The DF Tests and the ADF Tests, with constant and with tendency, at a 5% significance level – TV Cabo (*bp* variable)

Variable	DF Tests and ADF Tests			AIC	SBC	PQ(12)	LM Test
	Observed δ	*Lags*	Critical δ				
bp	-2,6236	0	-3,5484	-5,1195	-4,9848	0,150	LM1=0,7177 LM4=0,4454

Notes:

[*] The *bp* variable is the price of the basic cable television service.

[**] The time series that is used here corresponds to the natural logarithm of the variable in study.

[***] The number of lags included in the models, is the one which provides the elimination of the error autocorrelation.

[****] The critical value was collected from MacKinnon (1996).

Table II. – The DF Tests and the ADF Tests, with constant and without tendency, at a 5% significance level – TV Cabo (*pen* and *bd* variables)

Variables	DF Tests and ADF Tests			AIC	SBC	PQ(12)	LM Test
	Observed δ	*Lags*	Critical δ				
pen	-2,4546	3	-2,9604	-2,7764	-2,5451	0,504	LM1=0,5216 LM4=0,0989
bd	-2,7175	1	-2,9540	1,4985	1,6346	0,848	LM1=0,3304 LM4=0,4665

Notes:

[*] The *pen* variable is the penetration rate of the cable television service; and the *bd* is the variation of the number of subscribers of the cable television service.

[**], [***], and [****] are applied in a similar way.

Table III. – The DF Tests and the ADF Tests, with constant and with tendency, at a 5% significance level – Cabovisão (*bp* variable)

Variable	DF Tests and ADF Tests			AIC	SBC	PQ(12)	LM Test
	Observed δ	*Lags*	Critical δ				
bp	-2,9654	0	-3,5875	-4,6194	-4,4754	0,112	LM1=0,2858 LM4=0,6529

Table IV. – The DF Tests and the ADF Tests, with constant and without tendency, at a 5% significance level – Cabovisão (*pen* and *bd* variables)

Variables	DF Tests and ADF Tests			AIC	SBC	PQ(12)	LM Test
	Observed δ	*Lags*	Critical δ				
pen	-0,9982	2	-2,9862	-2,0316	-1,8366	0,351	LM1=0,7856 LM4=0,8722
bd	-2,5216	0	-2,9762	2,7557	2,8517	0,837	LM1=0,7674 LM4=0,7288

Table V. – Selection of the Optimal Number of Lags – TV Cabo

Lags	LogL	LR	FPE	AIC	SBC	HQ
0	49.9579143918	NA	7.25E-07	-2.785328	-2.603933	-2.724294
1	143.275444682	158.3570*	6.75E-09*	-7.471239*	-6.564265*	-7.166070*
2	157.30850259	20.41172	7.98E-09	-7.352030	-5.719477	-6.802726

Legend: NA = Not Available; * It identifies the optimal number of lags selected by each information criteria.

Table VI. – Detection of Error Autocorrelation in the TV Cabo VAR Model

Lags	AIC	SBC	PQ(12)	PQ(12) Ad.	Teste LM
1	-5,9975*	-4,3649*	0,9994	0,8772	LM1= 0,2598 LM4= 0,2009
2	-5,6593	-3,2775	0,9986	0,8494	LM1= 0,0864 LM4= 0,3000

Legend: * It identifies the number of lags which provides the minimization of the values of the information criterias: AIC and SBC.

Table VII. – Selection of the Optimal Number of Lags – Cabovisão

Lags	LogL	LR	FPE	AIC	SBC	HQ
0	9.80377157291	NA	7.52E-06	-0.446444	-0.252891	-0.390708
1	64.1135519039	87.73118	4.03E-07	-3.393350	-2.425584*	-3.114668
2	88.3902574284	31.74646*	2.35E-07*	-4.030020*	-2.288040	-3.528393*

Legend: NA = Not Available; * It identifies the optimal number of lags selected by each information criteria.

Table VIII. – Detection of Error Autocorrelation in the Cabovisão VAR Model

Lags	AIC	SBC	PQ(12)	PQ(12) Ad.	Teste LM
1	-2,6124*	-1,2575*	0,9994	0,6270	LM1= 0,6307 LM4= 0,4715
2	-1,5077	-1,0274	0,5430	0,0010	LM1= 0,2532 LM4= 0,8319

Legend: * It identifies the number of lags which provides the minimization of the values of the information criterias: AIC and SBC.

Table IX. – Cointegration Tests – TV Cabo

		Hypothesis				Hypothesis				Critical Values	
EV		H_0	H_1	λ_{Max}		H_0	H_1	λ_{Trace}		λ_{Max}	λ_{Trace}
0.568603		r=0	r=1	27.74401		r=0	r>0	58.49374*		27.07	47.21
0.411969		r=1	r=2	17.52219		r≤1	r>1	30.74973*		20.97	29.68
0.272025		r=2	r=3	10.47714		r≤2	r>2	13.22754		14.07	15.41
0.079967		r=3	r=4	2.750401		r≤3	r>3	2.750401		3.76	3.76

Notes:

[+] The time series that are used correspond to the natural logarithms of the variables *pen*, *bd*, *bp*, and the dummy regarding the *vis*.

[++] The first column corresponds to the Eigenvalues (EV).

[+++] The critical values of the statistics of the Trace Statistic and of the Max-Eigenvalue Statistic, at a significance level of 5%, were collected from Osterwald-Lenum (1992).

* It denotes the rejection of the initial hypothesis, at a significance level of 5%.

Table X. – Cointegration Tests – Cabovisão

		Hypothesis				Hypothesis				V. Críticos	
EV		H_0	H_1	λ_{Max}		H_0	H_1	λ_{Trace}		λ_{Max}	λ_{Trace}
0.622683		r=0	r=1	25.34141		r=0	r>0	50.91245*		27.07	47.21
0.389837		r=1	r=2	12.84475		r≤1	r>1	25.57104		20.97	29.68
0.295874		r=2	r=3	9.120738		r≤2	r>2	12.72630		14.07	15.41
0.129489		r=3	r=4	3.605558		r≤3	r>3	3.605558		3.76	3.76

Notes:

[+], [++], and [+++] are applied in the same way.

* It denotes the rejection of the initial hypothesis, at a significance level of 5%.

Table XI. – The Granger Causalities Contrasts – TV Cabo

	ΔLOGPEN	**ΔLOGBD**	**ΔLOGBP**	**ΔVIS**	**Block**	**ECT1**	**ECT2**
ΔLOGPEN	-	0.133670	0.222011	0.009025	0.731431	0.057561	0.010825
ΔLOGBD	0.093123	-	0.264630	0.001021	0.392845	-0.510196	-0.481840
ΔLOGBP	2.257484	9.018885*	-	1.594273	11.68251*	0.022750♦	-0.012301
ΔVIS	5.796491*	6.011586*	0.237488	-	11.74127*	0.339310♦	0.282721♦

Notes:

[x] For a better understanding of Table XI consider the variable or the block, expressed in each column, as being the independent variable (that is, the origin of the causality), and the variable presented in line, as being the dependent variable (that is, the destiny of the causality).

[xx] The causality contrasts are made through the application of the χ^2 statistic, with one degree of freedom, whereas the significance contrasts applied to the coefficients of the error correction terms (ECT1, and ECT2), are made through the use of the *t* statistic.

* Significance level: 5%.

♦ The coefficient is significant, since the absolute value of the *t* statistic t is bigger than the critical value.

Table XII. – The Granger Causalities Contrasts – Cabovisão

	ΔLOGPEN	ΔLOGBD	ΔLOGBP	ΔVIS	Block	ECT1
ΔLOGPEN	-	1.995735	5.765997*	0.429301	6.329231**	-0.219605♦
ΔLOGBD	0.036362	-	1.061835	0.086733	1.524532	0.204241
ΔLOGBP	0.281001	0.231371	-	0.080154	0.614640	0.052112♦
ΔVIS	0.000246	0.778378	0.088809	-	1.491488	-0.169091

Notes:

[x] For a better understanding of Table XII consider the variable or the block, expressed in each column, as being the independent variable (that is, the origin of the causality), and the variable presented in line, as being the dependent variable (that is, the destiny of the causality).

[xx] The causality contrasts are made through the application of the χ^2 statistic, with one degree of freedom, whereas the significance contrasts applied to the coefficients of the error correction term (ECT1) are made through the use of the *t* statistic.

* Significance level: 5%.

** Significance level: 10%.

♦ The coefficient is significant, since the absolute value of the *t* statistic t is bigger than the critical value.

Table XIII. – Percentage Weights of the Causality Relations – TV Cabo

Hypotheses	Causality Relations			Percentage Weights			
				4 Trimesters	8 Trimesters [9]	12 Trimesters	24 Trimesters
	LOGBD	→	LOGPEN	0,12	0,76	1,03	1,30
	LOGBP	→	LOGPEN	3,86	5,20	5,66	6,04
	VIS	→	LOGPEN	0,18	0,40	0,50	0,60
H3	LOGPEN	→	LOGBD	34,56	27,35	23,42	17,94
	LOGBP	→	LOGBD	1,70	3,03	4,54	7,38
	VIS	→	LOGBD	3,20	6,62	9,56	14,62
H1	LOGPEN	→	LOGBP	17,49	22,26	31,89	52,27
H5	LOGBD	→	LOGBP	14,14	14,25	12,31	7,87
H2	VIS	→	LOGBP	1,60	1,84	2,03	2,49
	LOGPEN	→	VIS	9,36	20,14	26,71	33,39
H4	LOGBD	→	VIS	34,87	45,70	47,92	49,25
	LOGBP	→	VIS	10,57	5,72	3,70	1,88

Table XIV. – Percentage Weights of the Causality Relations – Cabovisão

Hypotheses	Causality Relations			Percentage Weights (in %)			
				4 Trimesters	8 Trimesters [11]	12 Trimesters	24 Trimesters
	LOGBD	→	LOGPEN	4,87	6,20	6,56	6,93
	LOGBP	→	LOGPEN	7,09	20,77	23,57	26,61
	VIS	→	LOGPEN	0,25	0,23	0,21	0,19
H3	LOGPEN	→	LOGBD	17,20	15,36	14,76	14,12
	LOGBP	→	LOGBD	3,37	2,56	2,35	2,11
	VIS	→	LOGBD	0,20	0,29	0,32	0,34
H1	LOGPEN	→	LOGBP	34,97	50,12	55,70	62,29
H6	LOGBD	→	LOGBP	2,41	2,97	3,22	3,50
H2	VIS	→	LOGBP	0,16	0,32	0,35	0,39
	LOGPEN	→	VIS	21,22	22,80	23,25	23,70
H4	LOGBD	→	VIS	10,71	9,01	8,51	8,00
	LOGBP	→	VIS	5,23	6,62	6,93	7,25

Foot Notes:

[1] This effect respects the traditional Demand Law, which states that: for an increase in the price corresponds a decrease in the demanded quantity.

[2] In the USA, the subscription prices were deregulated in The Cable Act of 1984; they were re-regulated in the Cable Act of 1992, and they became again deregulated with the adoption of the Telecommunications Act of 1996.

[3] For revisions about the main developments of the VAR Model, see Holtz-Eakin, Newey and Rosen (1988), Lütkepohl (1991, 2004), Banerjee, Dolado, Galbraith and Hendry (1993), Hamilton, (1994), Canova (1995), Hendry (1995), Johansen (1995), Hatanaka (1996), Favero (2000), and Canova and Ciccarelli (2003).

[4] This analysis is obtained through the application of a VAR Model, which allows performing an interpretative analysis of the external shocks to the system.

[5] The data was collected from the National Regulatory Agency, the Autoridade Nacional de Comunicações (ANACOM).

[6] For example, the period between the first Trimester of 1995 and the third Trimester of 2003, is represented by: 1^{st}T: 1995, till the 3^{rd}T:2003).

[7] In the present case, we have a reduced number of observations; therefore, it is not convenient to use a big number of lags. For this reason, we consider only the probability of 12 coefficients of autocorrelation to be equal to zero (Marques, 1998).

[8] For a graphic representation about the Variance Decomposition of Cholesky (24 Trimesters) – TV Cabo, please see the Figure 1, of the Annex 1.

[9] We only consider as direct and significant impacts over the variance of the forecast error, values bigger than 5%, for a forecast horizon with 8 Trimesters (Goux, 1996, p.671).

[10] For a graphic representation of the Variance Decomposition of Cholesky (24 Trimesters) – Cabovisão, please see the Figure 2, of the Annex 2.

[11] As it was, previously, considered in the incumbent case, we also consider as direct and significant impacts on the variance of the forecast error, values bigger than 5%, for a forecast horizon with 8 Trimesters (Goux, 1996, p.671).

[12] For more details, please consult the Table XV, of the Annex 1.

[13] According to Goux (1996), the signal of the causality weight is obtained through the sum of the values of the coefficients of the impulse-response functions, which are obtained for a forecast horizon of 10 trimesters.

[14] This situation reflects the dominant position exercised by the historic operator: Portugal Telecom (PT); in the different Telecommunications Subsectors in Portugal, and the simultaneous property of the national fixed telephone network, and the cable network.